

NEW SPECIES AND HOST PLANTS OF THE *ANTHONOMUS GRANDIS*  
SPECIES GROUP (COLEOPTERA: CURCULIONIDAE)

ROBERT W. JONES AND HORACE R. BURKE

(RWJ) El Colegio de la Frontera Sur, Carretera Panamerica y Periférico Sur, Apartado Postal 63, San Cristóbal de las Casas, Chiapas, México (present address: Licenciatura en Biología, Universidad Autónoma de Querétaro, AP184, Querétaro, QRO, México CP76010); (HRB) Department of Entomology, Texas A&M University, College Station, TX 77843-2475, U.S.A.

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*Abstract.*—Three new species of the *Anthonomus grandis* group are described and illustrated, and a key distinguishing the five species of the group is presented.

*Anthonomus townsendi*, n. sp., and *A. palmeri*, n. sp., occur in the State of Chiapas, México, and *A. mallyi*, n. sp., occurs in Costa Rica. Host plants of these species are members of the genus *Hampea* (Malvales: Malvaceae). The taxonomic and ecological interrelationships of the weevil taxa and their malvaceous hosts are discussed.

*Key Words:* Curculionidae, *Anthonomus*, new species, México, Costa Rica, *Hampea* hosts

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Since the boll weevil, *Anthonomus grandis* Boheman, was first recognized as a pest of cotton in the late 1800's considerable effort has been expended in attempts to understand its origin, systematics, and host relationships (Burke et al. 1986). Until recently, the lack of knowledge of relatives of the boll weevil hindered meaningful comparative studies of its phylogeny and ecology. *Anthonomus hunteri* Burke and Cate, the first species recognized as having close morphological affinities to *A. grandis*, was described in 1979 (Burke and Cate 1979). Before the present study, these were the only two known species of the *A. grandis* group as defined by Clark and Burke (1986). Three new species are added to the group in the present paper.

Both of the previously known species of this group are almost entirely restricted to larval development on certain Malvaceae of the tribe Gossypieae, including *Gossypium*, *Hampea*, *Cienfuegosia*, and *Thespesia*. *An-*

*thonomus hunteri* is known to develop only on *Hampea trilobata* Standley, a plant endemic to the Yucatan Peninsula, Belize and northern Guatemala, while *A. grandis* has a wider host range within Gossypieae (Burke et al. 1986, Cross et al. 1975, Fryxell and Lukefahr 1967, Fryxell 1969). *Anthonomus grandis* was thought to be specific to Gossypieae until Bodegas et al. (1977) discovered members of the species developing on *Hibiscus pernambucensis* Arruda of the tribe Hibisceae in Chiapas, México.

A growing body of evidence indicates that *Hampea* is the ancestral host plant genus of the *A. grandis* species group. Both previously known species of the group utilize *Hampea* as hosts, and *A. hunteri* develops exclusively on *H. trilobata*. The three new species of the *A. grandis* group described herein also utilize species of *Hampea* as hosts. Further evidence of an ancestral relationship of the weevils with plants of the genus *Hampea* includes the

following: 1) large populations of *A. grandis* occur on *Hampea nutricia* Fryxell in southern México in the absence of cultivated or wild cotton; 2) the parasite guild of weevils on *Hampea* is more diverse than that for weevil populations on cotton (Burke et al. 1986, Cate et al. 1990); and, 3) *A. grandis* and *A. hunteri* have behavioral adaptations apparently specific to *Hampea* plants that suggest long periods of association (Stansly 1985).

Since *Hampea* has been shown to be the likely original host genus of the boll weevil, considerable interest has been generated regarding the ecology of these plants and their interactions with weevils. *Hampea* contains 21 described species from both the Gulf and Pacific coasts of México and southward into Colombia, with the greatest species diversity occurring in Chiapas, México and Guatemala (Fryxell 1969, 1979). Only four species of *Hampea* have been previously reported as hosts of *Anthonomus*, three of these being utilized by *A. grandis* and one by *A. hunteri*. Nine additional species of *Hampea* were examined during the present study. Four of these were found to serve as hosts of three heretofore undescribed species of the *A. grandis* group. With the *A. grandis* species group now being comprised of five species, it is possible to conduct a detailed comparison of the these taxa to assist in analyzing their origin, ecology, and host and phylogenetic relationships. The objectives of the present paper are to describe the three new species, compare them with their previously known relatives, and to report on the current status of eight species of *Hampea* in México and Central America as hosts of members of the *A. grandis* species group. A cladistic analysis of both the weevils and their *Hampea* hosts is underway. Additional papers on the ecology and genetics of this weevil group are also being prepared.

#### METHODS AND MATERIALS

Determination of the status of species of *Hampea* as hosts of *Anthonomus*.—During

the years 1987–1990, 1992, and 1995 nine species of *Hampea* not previously known to be hosts of *Anthonomus* were examined for evidence of weevil infestations in México, Guatemala, Belize, and Costa Rica. Examined were: *Hampea appendiculata* (J. Donnell-Smith) Standley, *Hampea bracteolata* Lundell, *Hampea integerrima* Schlechtendal, *Hampea longipes* Miranda, *Hampea mexicana* Fryxell, *Hampea montebellensis* Fryxell, *Hampea platanifolia* Standley, *Hampea stipitata* S. Watson, and *Hampea tomentosa* (K. Presl) Standley. These species were located in the field on the basis of distributional records obtained from specimens in the following herbaria: United States Department of Agriculture Cotton Laboratory, College Station, TX; Herbario Nacional, Universidad Autónoma de México, México, D.F.; and University of Texas, Austin, TX. Paul A. Fryxell (pers. comm.), specialist on the systematics of this group, also provided additional information useful in locating the plants. Each tree was examined for the presence of weevils and for evidence of feeding and oviposition both on the tree and in fallen flower buds. Potentially infested buds were enclosed in vials in the laboratory to allow for emergence of adult weevils.

Comparisons and descriptions of weevils.—To establish the relationships of the weevils collected and reared during this study, it was necessary to compare specimens reared from *Hampea* with those from other malvaceous hosts. A total of 761 adults of the *A. grandis* species group from 13 species of Malvaceae was examined. In addition to weevils from eight species of *Hampea*, material was studied from *Gossypium hirsutum* L., *Gossypium thurberi* Todaro, *Cienfuegosia rosei* Fryxell, *Cienfuegosia drummondii* A. Gray, and *Hibiscus pernambucensis* Arruda.

Comparisons were made between adult weevils from the entire range of known hosts plants. Characters used by Burke (1986) and Burke et al. (1986) to distinguish the three recognizable forms of *A.*

*grandis* (Southeastern, Mexican, and Thurbria), and by Clark and Burke (1986) in a phylogenetic study of the *A. grandis* group were used here. Characters examined included the shape and arrangement of pronotal and elytral scales, shape of profemur, shape and alignment of scutellum, coloration of antennae, and size and shape of body. The male median lobe proved to be especially useful in distinguishing species of the group. Analysis of specimens of *A. grandis* reared from various host plants aided in evaluation of the effects of these hosts on the general morphology and intraspecific variation within the species group. A considerable amount of previously accumulated information on host-induced and geographic variation of *A. grandis* provided a basis for comparison and evaluation of the taxonomic status of the newly collected weevils on *Hampea*.

Measurements were made with an eyepiece micrometer in a stereoscopic microscope. The size of the weevils was determined in a lateral view by measuring from the anterior margin of the eye to the apex of the elytra. The length of the rostrum was determined by measuring the chord from the lower anterior margin of the eye to the apex of the rostrum. Other structures were measured at the point of their greatest length or width.

## RESULTS

Host plants.—Weevils of the *A. grandis* group were reared from four species of *Hampea* not previously reported as hosts: *H. appendiculata* (Coastal Plain of eastern Costa Rica); *H. longipes* (Central Highlands of Chiapas); *H. mexicana* (Central Depression of Chiapas); and *H. montebellensis* (eastern Chiapas). Five additional species of *Hampea* (*H. bracteolata*, *H. integerrima*, *H. platanifolia*, *H. stipitata*, and *H. tomentosa*) were examined but no weevils were found associated with these. Several relatively large populations of *H. stipitata* and *H. integerrima* proved to be uninfested during a period of two years of

monitoring. Both of these species of plants were heavily laden with flower buds at the times of observation and, furthermore, they occurred within the flight range of *A. grandis* on *H. nutricia* in the states of Veracruz and Chiapas. Conditions appeared to be excellent for weevils to develop on these plants but accumulated evidence indicated that they did not do so. Because of their isolated distributions and relative rarity, only small populations of *H. platanifolia*, *H. bracteolata*, and *H. tomentosa* were found. Although the few trees observed were large and bore numerous flower buds, they were apparently not infested with weevils.

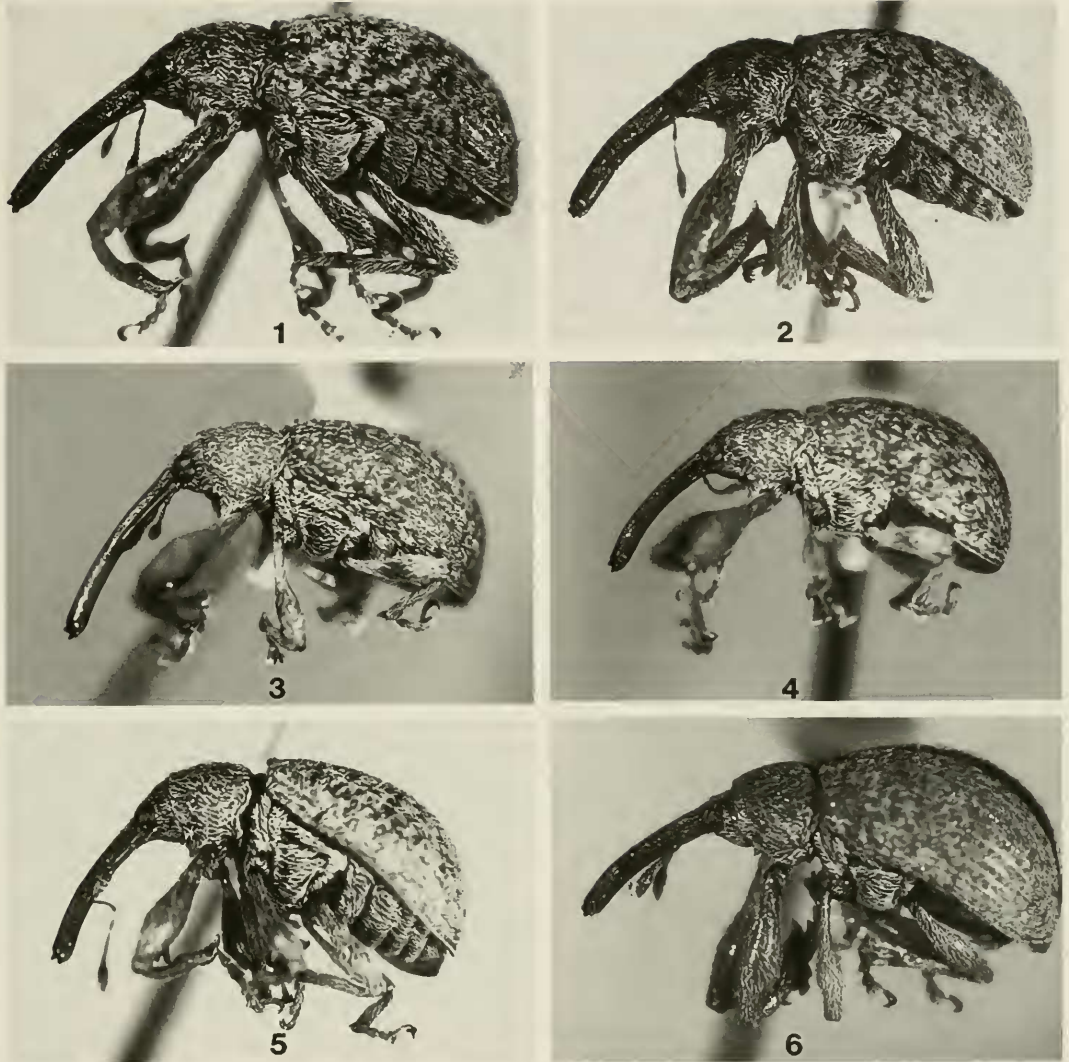
Definition of group.—*Anthonomus grandis*, *A. hunteri* and the three new species described herein are considered to be members of the same species group because of their close morphological and host plant affinities, although it is not possible to describe the group precisely on the basis of shared apomorphies. All of the species of the group develop in flower buds, and occasionally fruits, of Malvaceae of the tribe Gossypieae. In addition to its cotton tribe hosts, one population of *A. grandis* develops on *Hibiscus pernambucensis*, tribe Hibisceae. The latter association is apparently the result of a recent, localized host shift which should not detract from the fact that the members of the group obviously evolved on closely related hosts in the tribe Gossypieae, probably in the genus *Hampea*. The weevils of this group are also of a relatively large size for the genus, generally averaging approximately 4 to 5 mm in length and are occasionally larger. There are other tropical anthonomines of similar or larger size, for example in the genus *Loncophorus*, but the relationship of these to *Anthonomus*, and specifically to the *A. grandis* group, has not been determined (see Clark 1988, 1995, for further discussion of this problem). Furthermore, known hosts of species of *Loncophorus* are all members of the families Bombacaceae and Tiliaceae. While these plant families are

closely related to Malvaceae we do not believe that this, in itself, is sufficient evidence to closely ally *Lonchophorus* and the *A. grandis* group. In addition to the characters mentioned above that are shared by species of the *A. grandis* group, they have similar subconical heads, coarse hair-like to scale-like setae that are more-or-less evenly distributed over the body, rounded sides of the elytra as compared with the wedge-shaped or "navicular" elytra characteristic of most *Lonchophorus*, and do not have prothoracic postocular lobes as do species of the latter genus. The *A. grandis* group was compared to the subgenus *Anthonomorphus* Dietz of the genus *Anthonomus* by Clark and Burke (1986). Species of *Anthonomorphus* also develop on malvaceous plants, but unlike the *A. grandis* group, their hosts are in the tribe Malveae. In addition, the two groups differ in several morphological characters, most notably in the shapes of the male mesotrochanters and median lobes. While *Anthonomorphus* and the *A. grandis* species group may not be sister groups, there is still sufficient evidence to warrant further consideration of their relationships. Clark (1995) suggested that *Lonchophorus*, *Anthonomorphus*, and the *A. grandis* species group may constitute a monophyletic lineage confined to the Malvales. Additional study of certain Neotropical members of the tribe Anthonomini, especially the species of *Lonchophorus* and its allies, is needed to help clarify the overall relationships of species of the *A. grandis* group. Pending such a study, size, general habitus, vestiture, and narrow host ranges restricted almost entirely to plants in the tribe Gossypieae are used here to define the group.

KEY TO SPECIES

1. Rostrum slightly to moderately strongly carinate dorsally; hirsute only at base or may be nearly to completely bare; female rostrum slightly to moderately strongly curved (Figs. 3, 4, 5, 6). Elytral vestiture usually arranged in an orderly manner, with individual setae directed

- posteriorly. Male median lobe moderately to strongly curved in lateral view (Figs. 23, 24, 26, 27). Protibia slightly to moderately strongly sinuate on inner margin . . . . . 2
- Rostrum strongly carinate and hirsute dorsally from base to antennal attachments; female rostrum nearly straight (Fig. 1). Elytral vestiture arranged in irregular manner, with individual setae often directed obliquely or laterally. Male median lobe broadly rounded at apex; slightly curved ventrally in lateral view (Fig. 25). Protibia strongly sinuate on inner margin. Hosts *Hampea mexicana* and *H. latifolia*. Central and southern Chiapas, México, above 500 m . . . . . *A. townsendi* Jones and Burke, n.sp.
- 2. Rostrum of female slender; dorsal carinae poorly defined. Antennae of female attached at or near middle of rostrum. Male median lobe slightly (Fig. 24) to strongly (Fig. 26) constricted before tip . . . . . 3
- Rostrum of female stouter; dorsal carinae moderately strongly developed. Antennae of female usually attached well before middle of rostrum. Male median lobe broadly rounded to somewhat pointed at tip, but sides not constricted (Figs. 23, 27) . . . . . 4
- 3. Rostrum of both sexes moderately strongly curved. Profemur slender, length/width ratio 4.2-4.7. Male median lobe with sides slightly constricted before apex (Fig. 24). Host *Hampea trilobata*. Yucatan Peninsula, México, and Belize . . . . . *A. hunteri* Burke and Cate
- Rostrum of both sexes slightly curved (Figs. 3, 4). Profemur stouter, length/width ratio 3.0-3.5. Male median lobe strongly constricted before apex (Fig. 26). Host *Hampea appendiculata*. Costa Rica . . . . . *A. mallyi* Jones and Burke, n. sp.
- 4. Median vitta of setae on pronotum well defined. Setae on procoxae and sides of prothorax scale-like, with blunt apices (Figs. 18, 22). Male median lobe moderately strongly curved in lateral view; sides of apical portion converging strongly to blunt tip; length/width ratios of apical portion (measured from retracted phallosome to tip) 1.2-1.7 (Fig. 23). Hosts *Gossypium* spp., *Cienfuegosia* spp., *Thespesia populnea*, *Hibiscus pernambucensis*, *Hampea nutricia*, *H. rovirosae*, and *H. latifolia*. United States, México, Central America, Venezuela, Colombia, Brazil, and Argentina . . . . . *A. grandis* Boheman
- Median vitta of setae on pronotum absent or poorly defined; setae on procoxae and sides of prothorax narrow, with apices sharply pointed (Figs. 17, 21). Male median lobe slightly curved in lateral view; sides of apical portion broadly rounded to tip; length/width ratios of



Figs. 1-6. 1. *Anthonomus townsendi*, female. 2. *A. townsendi*, male. 3. *Anthonomus mallyi*, female. 4. *A. mallyi*, male. 5. *Anthonomus palmeri*, female. 6. *A. palmeri*, male.

apical portion 0.7-1.0 (Fig. 27). Hosts *Hampea montebellensis* and *H. longipes*. Central Highlands and eastern Chiapas, México, above 1000 m . . . . . *A. palmeri* Jones and Burke, n. sp.

#### SPECIES DESCRIPTIONS

##### *Anthonomus townsendi* Jones and Burke, NEW SPECIES

(Figs. 1, 2, 7, 8, 15, 19, 23)

*Body* oblong-oval; length 4.17-6.25 mm ( $x = 5.62$ ,  $n = 30$ ); width 1.92-2.92 mm ( $x = 2.60$ ,  $n = 30$ ). Integument shining,

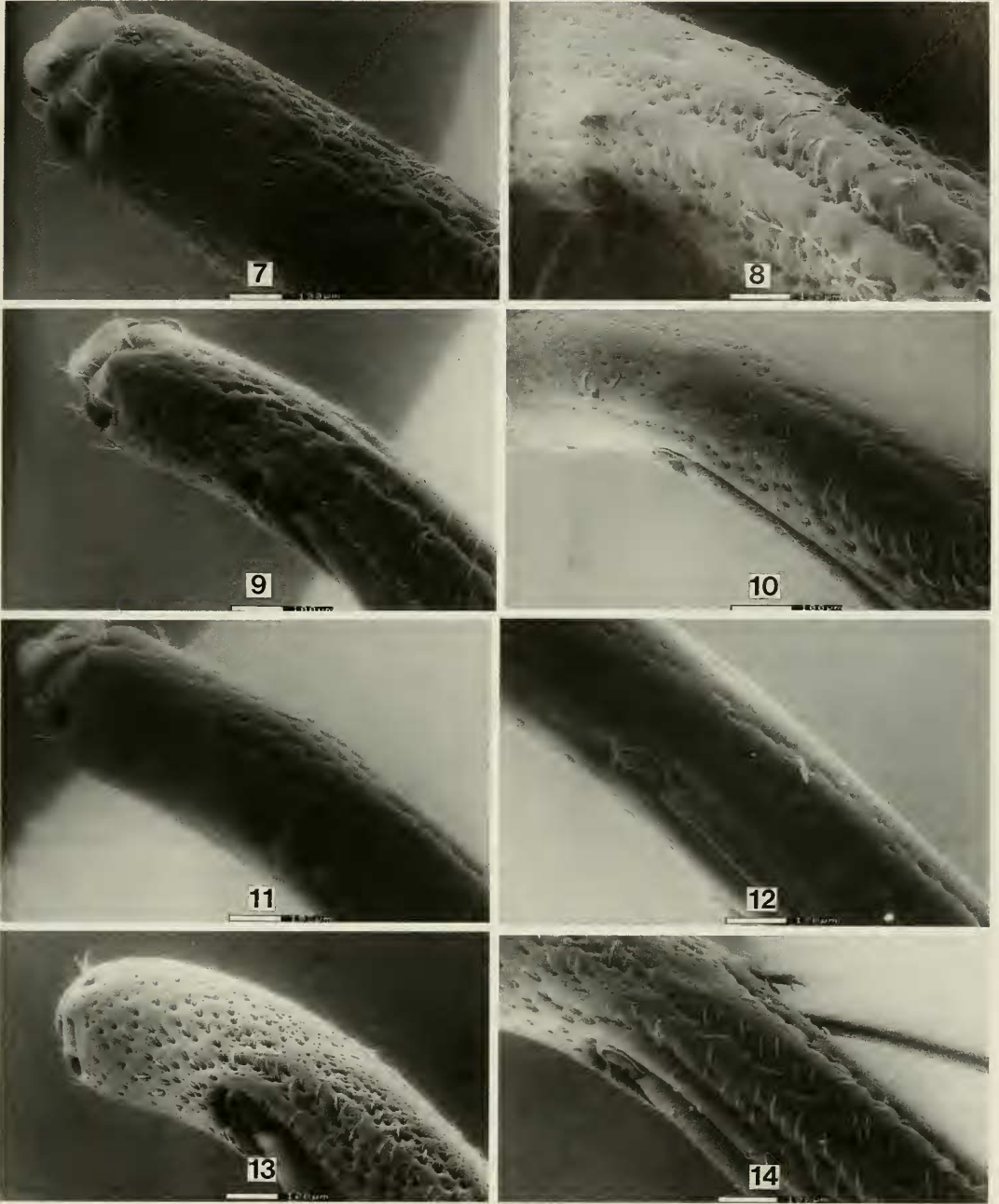
dark brown; head and rostrum sometimes darker than thorax and abdomen. Vestiture of coarse, recumbent, straw-colored pubescence; arranged in irregular patches on elytra (Figs. 1, 2); concentrated along midline of pronotum; elsewhere on prothorax fine and slightly broader setae intermixed; on underside and legs pubescence uniformly distributed. *Rostrum* of both sexes feebly curved, that of male (Fig. 2) being slightly more strongly curved than female (Fig. 1); ca. 2× longer than prothorax along midline

in both sexes. Median and lateral rostral carinae strongly developed in male, less so in female; carinae and associated pubescence of male extending from base past antennal insertion (Fig. 7), in female extending only to level of antennal insertion (Fig. 8). Distad of antennal insertion rostrum of male with deep, oval punctures, each bearing a seta longer than greatest diameter of puncture (Fig. 7), rostrum of female not as strongly punctate distally (Fig. 8). Eyes moderately convex in dorsal view; not free behind; separated in front by distance equal to  $\frac{3}{5}$  width of rostrum at base. Frons deeply foveate; moderately densely covered with fine coarse pubescence. *Antennae* attached ca. apical  $\frac{1}{4}$  of rostrum of male, ca. apical  $\frac{1}{3}$  in female. Funicle 7-segmented, 1.7–2.2 $\times$  longer than club; segment 1 slender, as long as next two segments combined; segment 2 slightly longer than 3 + 4. Club subequal to preceding five funicular segments combined; basal two segments loosely joined; apex sharply pointed. *Prothorax* with sides feebly rounded, subparallel in basal  $\frac{2}{3}$  then converging to subapical constriction; width at apex  $\frac{1}{2}$  width at base; integument shining, bearing large, rounded punctures that are smaller medially than laterally, areas between punctures smooth, bare, each puncture bearing an anteriorly projecting seta; vestiture concentrated into moderately dense median pronotal vitta, uniformly distributed laterally (Fig. 15) except slightly concentrated above coxae. *Scutellum* ca. 2 $\times$  longer than wide, rounded in cross section, sides parallel in apical  $\frac{1}{2}$ , expanding slightly at base; clothed above with appressed, fine scale-like setae that are concentrated in basal  $\frac{1}{3}$  and densely clothed at apex. *Elytra* strongly convex (Figs. 1, 2) in lateral view; slightly wider at base than prothorax; humeri moderately strongly rounded; sides subparallel to point past middle then strongly rounded to apex. Third elytral interval sometimes expanded basally. Pubescence arranged in regularly spaced patches presenting marmorate appearance, sometimes coalescing into more

linear patterns towards elytral apex. Intervals fairly strongly convex, especially on basal  $\frac{1}{2}$  of elytra. *Ventral side* of body with pubescence on thorax coarse, more hair-like on abdominal sterna. Procoxae contiguous. Mesocoxae separated by distance equal to ca.  $\frac{1}{4}$  width of coxa. Bare depression medially near posterior margin of metasternum. Abdominal sternum 1 along midline slightly longer than 2; sternum 3 ca.  $\frac{1}{3}$  longer than 4. *Legs* moderately stout (Figs. 1, 2); rather uniformly covered with coarse pubescence. Profemur 3.2–3.6 $\times$  longer than broad; bearing two teeth, the proximal of which is distinctly larger than triangular distal tooth. Meso- and metafemur ca. equal in size, each bearing a small tooth. Protibia curved in basal  $\frac{1}{3}$  and sinuate on inner margin (Fig. 1); meso- and metatibia straight and less strongly sinuate on inner margins. Tarsal claws each bearing long, slender tooth, the apex of which reaches past middle of claw. *Median lobe* of male genitalia feebly curved in lateral view; apex broadly rounded, distance from retracted phallosome to apex of median lobe less than width of median lobe (Fig. 25).

Type series.—Holotype  $\delta$ -México: 30 km N. D. Chanona, Chiapas, VI-29-1990, ex. *Hampea mexicana* (buds on ground), R. Jones. Paratypes (68): 9  $\delta$ , 8  $\eta$  with same label data as holotype. México: 9 km N. Nvo. Tenochtitlan, Mpio. Cintalapa, Chiapas, ex. *Hampea mexicana*, R. W. Jones (1  $\eta$ , VII-23-1988; 4  $\delta$ , 1  $\eta$ , VI-12-1991; 2  $\delta$ , 2  $\eta$ , VI-28-1991; 6  $\delta$ , 4  $\eta$ , VII-12-1991). México: 5 mi. N. Nvo. Tenochtitlan, Mpio. Cintalapa, Chiapas, VI-29-1990, ex. *Hampea mexicana*, R. W. Jones and D. Baro (11  $\delta$ , 11  $\eta$ ). México: Jiquipilas, 4 mi W. Fco. Villa, Chiapas, VIII-6-1989, Jones, Cate and Krauter, ex. *Hampea mexicana* (1  $\delta$ , 3  $\eta$ ). México: 19 km N. Mapastepec, Chiapas, VII-7, 1991, R. Jones, ex. *Hampea latifolia* ground buds (2  $\delta$ , 1  $\eta$ ); 1  $\delta$ , 1  $\eta$  same data as preceding except VIII-11-1991.

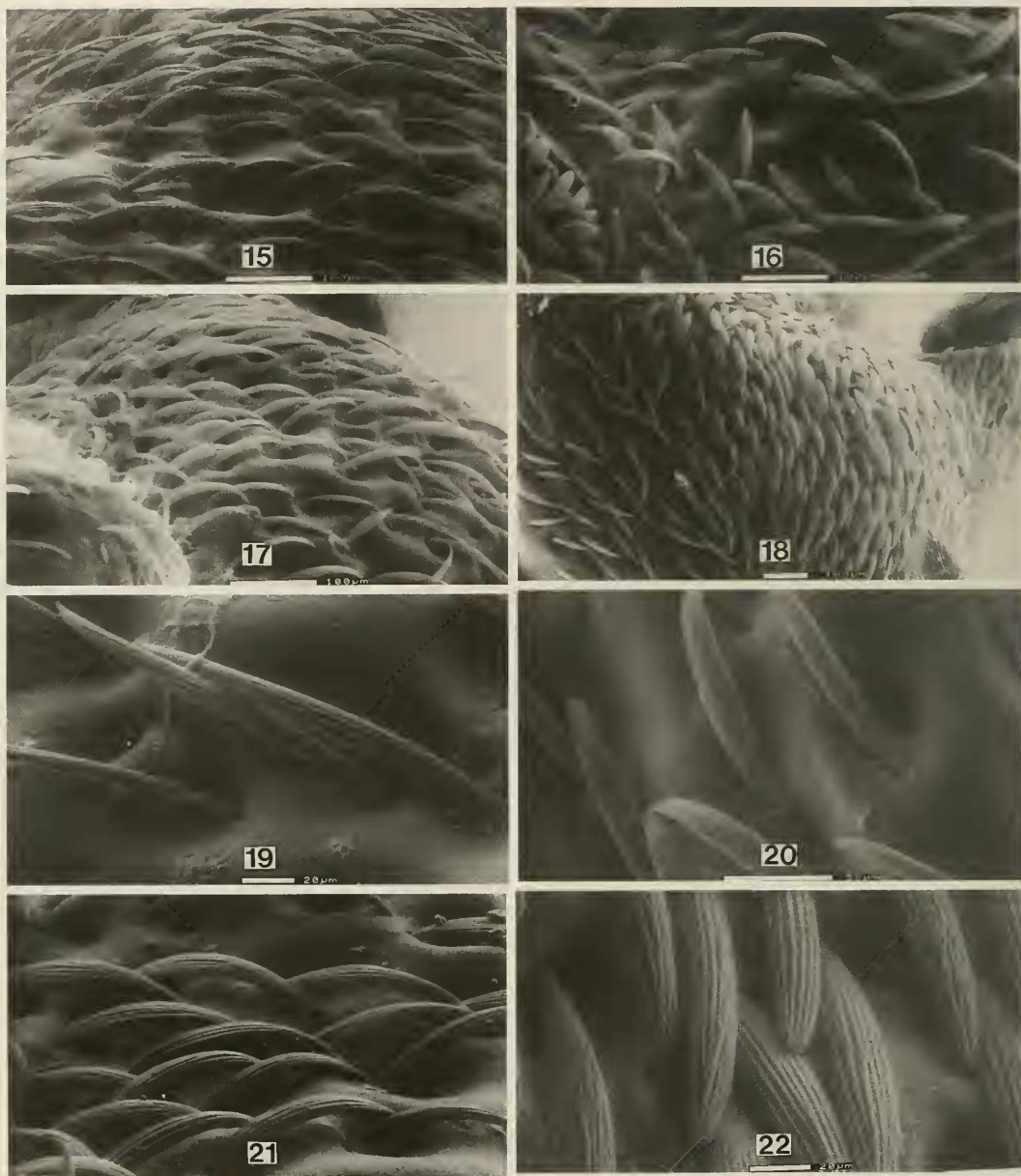
The holotype and some paratypes are deposited in the Insect Collection of the De-



Figs. 7-14. Rostra of: 7, *Anthonomus townsendi*, male. 8, *A. townsendi*, female. 9, *Anthonomus palmeri*, male. 10, *A. palmeri*, female. 11, *Anthonomus mallyi*, male. 12, *A. mallyi*, female. 13, *Anthonomus grandis*, male. 14, *A. grandis*, female.

partment of Entomology, Texas A&M University. Paratypes are deposited in the collections of: Instituto de Biología, Universidad Autónoma de México, D.F.; El

Colegio de la Frontera Sur, San Cristobal de las Casas, Chiapas, México; Auburn University; Canadian Museum of Nature, Ottawa, Canada; and Charles W. O'Brien.

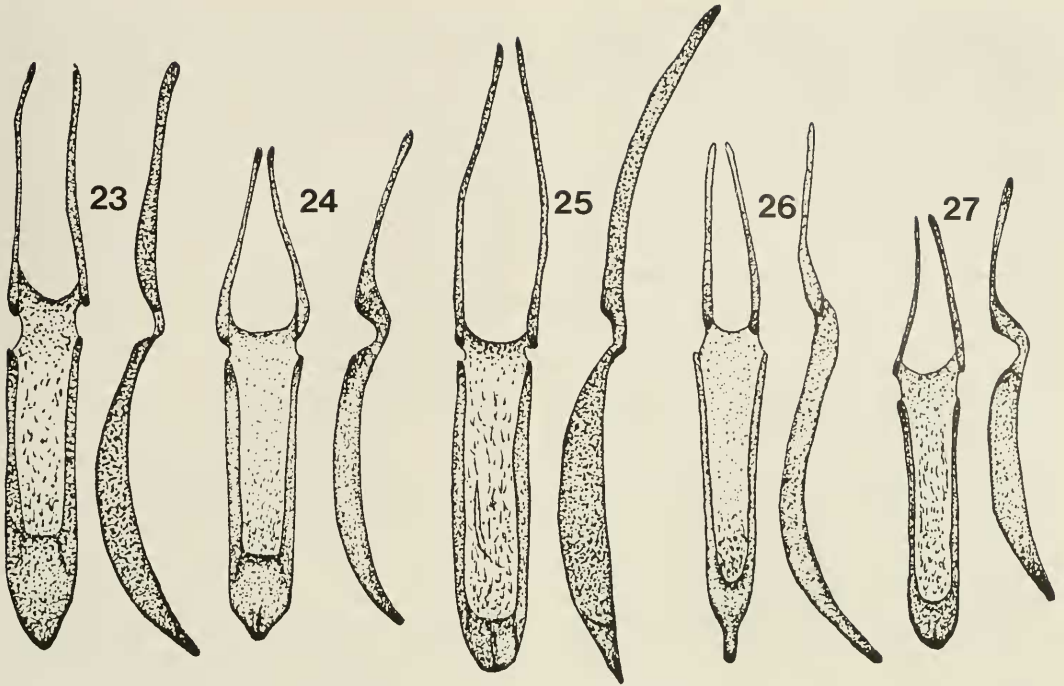


Figs. 15–22. Ventral one-half of pleural region of prothorax of: 15, *Anthonomus townsendi*. 16, *Anthonomus mallyi*. 17, *Anthonomus palmeri*. 18, *Anthonomus grandis* (ex *Hampea nutricia*). Dorsal one-half of pleural region of prothorax (above base of procoxa) of: 19, *Anthonomus townsendi*. 20, *Anthonomus mallyi*. 21, *Anthonomus palmeri*. 22, *Anthonomus grandis* (ex *Hampea nutricia*).

**Diagnosis and variation.**—Characters differentiating species of the *A. grandis* group are presented in the key. In general, *A. townsendi* is larger and more robust than other species of the group. The marmorate

appearance of the pubescence on the elytra is also distinctive. The female rostrum is less strongly curved than in the other species and the apical length (from antennal attachment to apex of rostrum) is distinctly





Figs. 23–27. Dorsal and lateral views of male median lobe of: 23, *Anthonomus grandis* (ex *Hampea nutricia*). 24, *Anthonomus hunteri*. 25, *Anthonomus townsendi*. 26, *Anthonomus mallyi*. 27, *Anthonomus palmeri*.

shorter relative to the rostrum width. The male rostrum of *A. townsendi* is the most densely hirsute of the members of the complex and also has the most strongly pronounced punctures and largest scales distad of the antennal insertion (Fig. 7). The protibia of *A. townsendi* is more strongly curved and the inner margin is more strongly sinuate than that of either *A. grandis*, *A. hunteri* or *A. mallyi*. The protibia of *A. palmeri* is curved basally like that of *A. townsendi* but as in other members of the group it is slender and the inner margin is not as sinuate. Furthermore, *A. townsendi* may be distinguished from the three recognized forms of *A. grandis* by the pubescence being uniformly distributed on the sides of the prothorax. The relatively straight median lobe in lateral view with the apex being wider than long also distinguishes this species from *A. grandis*, *A. hunteri*, and *A. mallyi*.

The major variation in the type series is in size. Specimens range from 4.2 to 6.3

mm in length. Teeth on the profemur show considerable variation in relative size. On some individuals the profemoral teeth are similar in size and shape to those of *A. grandis*. However, the smaller of the two profemoral teeth of *A. townsendi* is sometimes strongly reduced in comparison with the larger one. The larger profemoral tooth of *A. townsendi* is broader at the base than that of *A. grandis*. As is often the case with reared material, some of the individuals of the type series are somewhat teneral and are thus not as dark as would be expected of well hardened specimens.

Host plants.—Hosts of this species are *H. mexicana* in the Central Depression area of Chiapas, and *H. latifolia* on the slopes of the Sierra Madre de Chiapas above 500 m elevation. It is of interest to note that *H. latifolia* is also a host of *A. grandis* on the coastal plain near Tapachula, Chiapas. Specimens reared from the latter host population were clearly *A. grandis* and showed no overlap in distinguishing characters with

*A. townsendi* reared from *H. latifolia* in montane habitats of the Sierra Madre de Chiapas, approximately 100 km east of the *A. grandis* population. It is unknown whether the utilization of the same species of *Hampea* by the two weevils is the result of different habitat preferences or the result of a relatively recent displacement of *A. townsendi* by enormous populations of *A. grandis* developing on cultivated cotton in the coastal plain.

Derivation of name.—This species is named in honor of Charles Henry Tyler Townsend (1863–1944), the first entomologist to conduct scientific study of the boll weevil. Townsend studied the boll weevil under difficult conditions in South Texas in the late 1800's immediately after the first discovery of the pest in the United States (Townsend 1895). He also traveled widely in México and made extensive collections of insects there.

***Anthonomus mallyi* Jones and Burke,  
NEW SPECIES**

(Figs. 3, 4, 11, 12, 16, 20, 26)

*Body* elongate-oval; length 4.67–5.17 mm ( $\bar{x}$  = 4.98,  $n$  = 7); width 2.17–2.42 mm ( $\bar{x}$  = 2.32,  $n$  = 7). Integument shining, tan, head and rostrum brown (type series reared; specimens somewhat teneral; well hardened specimens expected to be darker). Vestiture sparse, consisting of fine, yellowish white, prostrate pubescence; shorter and irregularly distributed in patches on elytra (Figs. 3, 4); faint median vitta on pronotum; nowhere on body completely obscuring integument. *Rostrum* slightly curved in both sexes, that of female being nearly straight (Figs. 3, 4); rostrum of male 1.8 $\times$  and that of female 2.5 $\times$  longer than prothorax along dorsal midline; ratios of rostrum length past antennal insertion to width (measured in side view) 1.7 for male and 4.0 for female. Pubescence on rostrum of both sexes sparse, inconspicuous except near base, not extending distad of level of antennal insertions (Figs. 11, 12). Median and lateral carinae rounded, with intervening grooves

shallow, not quite reaching level of antennal insertions. Lateral rostral groove relatively well defined; upper margin impinging against front margin eye at about middle. *Eyes* moderately strongly convex in dorsal view, not free behind; separated in front by distance equal to ca.  $\frac{1}{2}$  width of rostrum at base. *Frons* foveate; vestiture sparse, about same density as on pronotum. *Antennae* attached at ca. apical  $\frac{3}{4}$  of rostrum in male and slightly distad of middle in female. Funicle 7-segmented; 1.5–1.8 $\times$  longer than club; segment 1 slender, 2 $\times$  length of segment 2, ca. as long as following four segments combined; remaining segments ca. equal in length. Club elongate, ca. as long as preceding six funicular segments combined; basal two segments loosely joined; apex sharply pointed. *Prothorax* with sides parallel in basal  $\frac{1}{2}$  then converging moderately strongly to subapical constriction; integument shining; elongate punctures smaller dorsally than laterally, each bearing an anteriorly pointing seta; areas between punctures bare, impunctate. Vestiture coalescing into faint to relatively well defined median vitta, laterally on pronotum uniformly distributed; scale-like setae on pleural region of prothorax striate (Fig. 20), stouter than those dorsally. *Scutellum* rectangular, parallel-sided, somewhat flattened dorsally, about 1.5 $\times$  longer than wide; sparsely clothed with appressed, fine setae. *Elytra* in lateral view moderately strongly convex at base in dorsal  $\frac{1}{3}$  (Figs. 3, 4); distinctly wider at base than prothorax; humeri moderately strongly rounded; sides subparallel to point past middle then strongly rounded to apex. Basal margin from third interval outward relatively straight. Pubescence arranged in more-or-less regularly spaced patches on basal  $\frac{1}{2}$  of elytra, coalescing into more linear patterns towards elytral apex. Intervals somewhat flattened. *Ventral side* of body clothed with pubescence that does not completely obscure integument, finer and less dense on legs. Procoxae contiguous. Mesocoxae separated by distance equal to ca.  $\frac{1}{4}$  width of

coxa. Abdominal sternum 1 along midline equal in length to sternum 2 + 3. *Legs* moderately stout (Figs. 3, 4). Profemora 3.0–3.5× longer than wide; bearing two teeth; basal tooth slightly quadrate, 1.8–3.1× longer than broadly triangular distal tooth. Meso- and metafemora ca. equal in size, each bearing a small, sharply pointed tooth. Protibia relatively straight, moderately sinuate on inner margin. Meso- and metatibiae each slightly sinuate on inner margin. Tarsal claws each bearing a long tooth on inner margin, the apex of which reaches past the middle of claw. Median lobe of male strongly curved in lateral view, especially in distal 1/3, length of apex (distance from retracted phallosome to apex of lobe) greater than width, apex strongly constricted (Fig. 26).

Type series.—Holotype ♂- EARTH School Reserve, Mpio: Pocora, Limón, Costa Rica, August 17, 1992, R. Jones and P. Krauter, Ex. *Hampea appendiculata*. Paratypes: 2 ♂s, 4 ♀s, same data as holotype.

The holotype and some paratypes are deposited in the Collection of the Department of Entomology, Texas A&M University. Paratypes are also deposited in the Museo Nacional de Costa Rica, San José, Costa Rica.

Diagnosis and variation.—The long, narrow rostrum of the female (Fig. 3) of *A. mallyi* is the most distinctive external character distinguishing this species from others in the group. The ratio of length of rostral apex (from antennal insertion to apex) to width (3.6–4.2) is significantly higher for females of *A. mallyi* than for the other species. The rostra of both the males and females of this species are the least densely hirsute of any members of the complex. Furthermore, the rostrum of the female is virtually devoid of distinguishable carinae (Fig. 12). The male median lobe is uniquely constricted at the apex (Fig. 26), readily distinguishing this species from all others with which it is likely to be confused.

There is little variation in the overall size

of the seven specimens of the type series. All of these specimens were reared from flower buds of equal size under constant conditions in the laboratory which may account for the uniformity in size. The variation noted in the color of the integument is probably due to the general condition of the reared specimens.

Host plants.—Members of the type series were reared from the flower buds of *Hampea appendiculata*. Although populations of *H. appendiculata* were examined at elevations ranging from 100 to 1200 m, the weevils were only found on trees occurring at the lowest level in moderately disturbed forests of the Atlantic coastal plain of Costa Rica.

Derivation of name.—This species is named in honor of Frederick W. Mally (1868–1939), the first entomologist employed by the State of Texas to study the biology and control of the boll weevil.

***Anthonomus palmeri* Jones and Burke,  
NEW SPECIES**

(Figs. 5, 6, 9, 10, 17, 21, 27)

*Body* oblong-oval; length 3.42–4.92 mm ( $\bar{x}$  = 4.11,  $n$  = 30); width 1.67–2.17 mm ( $\bar{x}$  = 1.90,  $n$  = 30). Integument of body shining, typically dark brown (some specimens of type series lighter in color due to general condition). Vestiture consisting of coarse, yellowish-white pubescence; scale-like setae somewhat broader and uniformly distributed on thorax, occasionally more densely concentrated on midline of pronotum; distributed in irregular patches on elytra (Figs. 5, 6). *Rostrum* moderately curved in both sexes; more strongly and evenly curved in female (Figs. 5, 6); male rostrum 1.7× and female 1.8× longer than prothorax along dorsal midline. Ratio of apical rostral length (from antennal insertion to apex) to rostrum diameter (in lateral view at level of antennal insertion) 1.6 for male and 2.6 for female. Pubescence on male rostrum variable in density, sometimes sparse, extending dorsally and laterally distad of antennal insertion, that of female ex-

tending to antennal insertion (Figs. 9, 10). Median and sublateral rostral carinae pronounced and extending to level of antennal insertion in both sexes. Lateral rostral groove well defined; dorsal margin impinging against eye at about middle. *Eyes* moderately convex in dorsal view, not free behind; separated in front by distance equal to ca.  $\frac{3}{5}$  width of rostrum at base. *Frons* deeply foveate; covered with fairly dense vestiture of fine, curved setae, not obscuring integument. Antennae attached at about apical  $\frac{3}{5}$  of rostrum in male and at slightly less than apical  $\frac{3}{4}$  in female. Funicle 7-segmented; segment 1 slender, approximately equal in length to next three funicular segments combined. Antennal club with basal two segments rather loosely joined; anterior margins of club segments bearing large scales; apex sharply pointed; subequal in length to preceding six funicular segments combined. Prothorax with sides parallel to subparallel in basal  $\frac{2}{3}$  then converging to distinct subapical constriction; width of apex of prothorax  $\frac{1}{2}$  width of base; integument shining, bearing deep punctures that are smaller dorsally than laterally; areas between punctures smooth, bare. Vestiture uniformly distributed laterally, punctures each bearing a scale-like seta (Fig. 21), sometimes with slight concentration of setae above coxae (Fig. 17). *Scutellum* ca.  $2\times$  longer than wide, sides parallel to subparallel; sparsely to densely covered with fine, appressed setae, more densely clothed at apex. *Elytra* strongly convex dorsally in basal  $\frac{1}{3}$ ; distinctly wider at base than prothorax; humeri moderately strongly rounded; sides subparallel to point past middle then strongly rounded to apices; basal margin slightly sinuate due to expanded third elytral interval. Elytral pubescence arranged in square to irregularly shaped patches on basal half of elytra; coalescing into more linear patterns towards elytral apex. Intervals slightly convex. *Ventral side* of body sparsely to densely clothed with fine to coarse pubescence. Procoxae contiguous. Mesocoxae separated by distance equal to

ca.  $\frac{1}{4}$  width of coxa. Abdominal sternum 1 along midline slightly shorter than 2. Sternum 3 about  $\frac{1}{3}$  longer than 4. *Legs* moderately stout (Figs. 5, 6). Profemur  $3.1-3.6\times$  longer than broad; bearing two teeth, the basal one being acutely pointed and  $1.5-2.5\times$  longer than broadly triangular distal tooth. Meso- and metafemora about equal in size, each bearing a small, triangular tooth. Protibia relatively stout, moderately strongly curved in basal  $\frac{1}{3}$ ; inner margin fairly strongly sinuate. Meso- and metatibiae not as strongly sinuate on inner margins. Tarsal claws each bearing a long slender tooth, the apex of which reaches past middle of claw. *Median lobe* of male slightly curved in lateral view; apex broadly rounded, width equal to distance from retracted phallosome to apex (Fig. 27).

Type series.—Holotype  $\delta$ - México: Chiapas, Tenejapa, below Paraje Yashanal, VII-3-1990, R. W. Jones and D. Baro, ex *Hampea longipes* (ground buds). Paratypes (55) as follows: Two  $\delta$ s with same data as holotype; 1  $\delta$ , 1  $\delta$  with same label data as holotype except collected VII-4-1990; 2  $\delta$ s with same label data as holotype except collected VII-25-1990; 1  $\delta$  with same label data as holotype except collected VI-26-1990; 1  $\delta$  with same label data as holotype except collected VII-14-1991 by R. W. Jones. One  $\delta$ , 2  $\delta$ s-México, Paraje Yashanal, Tenejapa, VIII-8-1989, R. Jones, J. Cate, P. Krauter, ex *Hampea longipes*. Two  $\delta$ s, 1  $\delta$ -Mexico-nr. Paraje Yashanal, Tenejapa, VII-2-1991, R. W. Jones, ex *Hampea longipes* (ground buds). Four  $\delta$ s and 9  $\delta$ s- México: nr. Laguna Cinco Lagos, Mpio. La Trinitaria, Chiapas, VII-4-1990, R. Jones and D. Baro, ex *Hampea montebellensis* (ground buds); 1  $\delta$  and 1  $\delta$  with same data except collected VIII-2-1990; 1  $\delta$  with same label data except collected VIII-11-1990; 3  $\delta$ s and 2  $\delta$ s with same label data except collected VIII-21-1990. Nine  $\delta$ s and 11  $\delta$ s- México: Lagunas de Montebello Natl. Park, VIII-9-1989, R. Jones, J. Cate, P. Krauter, ex *Hampea montebellensis*.

The holotype and some paratypes are deposited in the Insect Collection of the Department of Entomology, Texas A&M University. Paratypes are also deposited in the collections of: Instituto de Biología, Universidad Autónoma de México, México, D. F.; El Colegio de la Frontera Sur, San Cristobal de las Casas, Chiapas, Mexico; Canadian Museum of Nature, Ottawa, Canada; and Charles W. O'Brien.

Diagnosis and variation.—*Anthonomus palmeri* is generally the smallest member of the *A. grandis* complex although there is considerable size variation in this group of species. The small size of *A. palmeri* generally distinguishes it from *A. townsendi* which it most closely resembles. *Anthonomus palmeri* also has a more strongly curved rostrum with the antennae of the female attached farther from the base of the rostrum. In addition, the profemur of *A. townsendi* is more robust than that of *A. palmeri* and the proximal tooth is usually much larger than the distal tooth. The less strongly curved median lobe with its broader apex distinguishes *A. palmeri* from *A. grandis*, *A. hunteri*, and *A. mallyi*. Furthermore, *A. palmeri* is separated from *A. grandis* by having the scales on the pleural region of the prothorax uniformly distributed as compared to the patterned arrangement of the latter. The rostrum of the female of *A. palmeri* (Fig. 5) is more hirsute and the dorsal carinae are more distinct than in *A. mallyi* or *A. hunteri* (Figs. 10, 12).

As is common in this species complex, the major variation in the type series of *A. palmeri* is in size. Specimens range from 3.42 to 4.92 mm in length. The diagnostic characters are retained throughout the series regardless of size. The greatest overall variation in size occurs between specimens of the two host plant populations (*H. montebellensis* and *H. longipes*). Specimens of *A. palmeri* from *H. longipes* are the smallest weevils in the *A. grandis* group. Specimens from *H. montebellensis* are larger, though still relatively small compared to other species in the complex. The dorsal pronotal

vitta is absent on some individuals in the type series, most of which are from *H. longipes*. Scale patterns on the lateral margins of the prothorax vary slightly in uniformity of distribution. Some individuals have a distinct elliptical aggregation of scales above the procoxae as is found in *A. townsendi*; however, this aggregation is indistinct in other individuals. The color of the integument of the rostrum and prothorax varies from brown to almost black. Although there is some overlap in colors in specimens from the two hosts, weevils reared from *H. longipes* have the darkest integument while specimens reared from *H. montebellensis* are usually lighter in color.

Host plants.—The known hosts of *A. palmeri* are *H. longipes* in the Central Highlands of Chiapas, and *H. montebellensis* in the Lagunas de Montebello region of eastern Chiapas. These hosts occur above 1200 m in humid, relatively cool, montane forests.

Derivation of name.—This species is named in honor of Edward Palmer (1831–1911) who during his extensive natural history explorations of México was the first to report *A. grandis* as a pest of cotton. After having observed a cotton field heavily damaged by the boll weevil near Monclova in the state of Coahuila, México in 1880, he sent specimens to entomologists in Washington, D.C. His report alerted entomologists to the threat this weevil posed for cotton production.

#### DISCUSSION

As noted earlier, *A. townsendi*, *A. mallyi*, and *A. palmeri* are close allies of *A. grandis*. In fact, they were initially considered to be conspecific with *A. grandis*. However, further analysis of their characters indicated that they are distinct from the three recognized forms of *A. grandis* as well as from each other. Morphological analysis of a large number of specimens of *A. grandis* from throughout its geographic range and from its various hosts (Burke 1986, Burke et al. 1986) provided a basis for critical

comparison of the newly discovered species with this highly variable and widely distributed species. The most obvious and consistent character separating *A. grandis* from the other species of the group is the clear demarcation of densely arranged, blunt scale-like setae on the ventral one-half of the pleural region of the prothorax as compared to those on the dorsal one-half. This character is present on specimens of *A. grandis* from all host and geographic populations. This, and the distinctive male median lobe, confirms that the variable populations on all hosts other than *Hampea* are *A. grandis*. The second line of evidence that the taxa of *Anthonomus* described herein are distinct species comes from the apparent reproductive isolation based on host and geographic differences. Although species of the *A. grandis* group are not known to occur in sympatry, large populations of *A. grandis* on cultivated cotton often occur fairly close to some of the species on *Hampea*. For example, *A. grandis* was observed to occur in large numbers in a small, isolated cotton field ca. 50 kms from collection sites of *A. townsendi* on *H. mexicana* in the Central Depression area of Chiapas. Given the proven flight capabilities and abundance of *A. grandis*, the probability of eventual sympatry occurring between this species and *A. townsendi* would appear to be high, especially since *H. latifolia* is known to serve as host for both species. However, no sympatry or evidence that the two species interbreed have been found.

The discovery of three undescribed species of *Anthonomus* on four of the nine species of *Hampea* examined in the field reveals some interesting information about the association of species of the complex with their *Hampea* hosts. The restriction of *A. townsendi*, *A. mallyi*, *A. palmeri*, and the previously described *A. hunteri* to *Hampea* as hosts, and the fact that species of this plant genus also serve as occasional hosts of *A. grandis*, strongly supports the conclusion of Burke et al. (1986) that *Hampea* is the ancestral host genus of the entire group.

Since *Hampea* and members of the *A. grandis* group have apparently had a long association, the possibility is great that other undescribed species of related weevils remain to be discovered on the remaining eight species of *Hampea* not examined during this and previous studies. However, the fact that weevils of this group were not found on five species of *Hampea* examined in the field indicates that ecological, morphological, historical, and/or chemical factors may be involved in preventing infestations. Further field and taxonomic studies of both the *A. grandis* species complex and the genus *Hampea* may elucidate the factors involved and nature of the evolutionary processes in this insect/plant association. There is considerable urgency in conducting such studies since some species of *Hampea*, and possibly their associated weevils, may have recently been extirpated and others are clearly threatened.

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